

and, as such, would preclude a claim of “lost profits” and limit a claim of reasonable royalty. The alternative is clearly “acceptable” because it (1) is essentially interchangeable with the accused product, (2) would have been received favorably by customers, and (3) the decision to pursue the accused product was driven by secondary reasons (see above). Further, the alternative was clearly available since (1) very little additional work would have been (or was) required to fully develop the product, (2) all the components of the alternative film and know-how and equipment to produce the film was available, (3) there would have been little or no delay in selecting the alternative, and (4) there were no other hurdles (e.g., FDA) that would prevent introduction of the alternative.

### III. Conclusion

10. In view of the above, it remains my opinion that Cryovac’s damages in this matter are limited to a reasonable royalty for the alleged infringement by PPPI. Lost profits for alleged patent infringement are not recoverable in view of the availability (to PPPI) of an acceptable non-infringing alternative. In the unlikely event that “lost profits” for PPPI’s alleged infringement are found to be recoverable by Cryovac (i.e., if the jury believes that Cryovac has satisfied all four “prongs” of Panduit, as described in my initial Expert Report), the damages should be determined by multiplying PPPI’s actual alleged infringing sales, for which all four prongs are met, by Cryovac’s average net profit during the time period. Under no circumstances should the calculation include sales for which the “but for” test is not met. Moreover, the “lost profits” cannot include any sales occurring after the expiration of the ‘419 patent. I continue, however, to maintain that neither the “demand prong” nor the “absence of non-infringing alternatives prong” are met in this case. Damages for “tortious interference” or “unjust enrichment” are incapable of calculation, even if “tortious interference” or “unjust enrichment” can be established and, it is my opinion that neither can be established in view of the fact that no

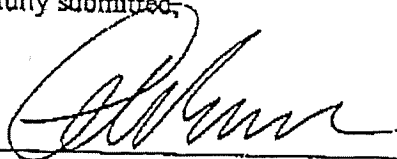
contract with "quantity" or "requirements" terms existed. This was confirmed (admitted) by Mr. Jeff Gardner of Cryovac in his recent deposition. Finally, with respect to reasonable royalty, the Grain Processing decision, cited in my prior reports, would limit the royalty rate to a nominal rate since production of the acceptable and available non-infringing alternative is, in fact, more economic than the accused product. In view of the conventional rates in the industry and the very nominal value of the patented technology (even if the asserted claim is found to be valid and PPPI is found to have infringed), it is my opinion that the reasonable royalty rate determined in the hypothetical negotiation would not have exceeded 2% of PPPI's alleged infringing sales.

IV. Right to Supplement

11. In view of the fact that discovery in this case is continuing and Mr. Nawrocki continues to indicate that he may again supplement his opinion, I reserve the right to supplement my opinion.

Respectfully submitted,

15 August 2005  
Dated

  
Larry W. Evans

**CERTIFICATE OF SERVICE**

I, Brian P. O'Donnell, an attorney, hereby certify that I caused true and correct copies of  
Second Supplemental Report of Larry W. Evans Pursuant to Federal Rules of Civil Procedure  
Rule 26(A)(2)(B) to be served on:

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This 15th day of August, 2005 via e-mail and first class mail.

  
\_\_\_\_\_  
Brian P. O'Donnell

# EXHIBIT 7

## **EXHIBIT 7**

**REDACTED IN ITS ENTIRETY**

# EXHIBIT 8

## **EXHIBIT 8**

**REDACTED IN ITS ENTIRETY**

# EXHIBIT 9



**From:** "O'Donnell, Brian P" <BODonnell@jenner.com>  
**To:** "Mark Feldstein" <mark.feldstein@finnegan.com>  
**Date:** 8/2/05 12:25PM  
**Subject:** Cryovac v. PPPI - M. Feldstein Ltr. 08/01/2005

Mark:

Steve asked me to respond to your letter of August 1, 2005. Regarding Item No. 1, the requested indemnification agreement is attached and bears production number PPPI 013482. You will also find attached an additional document responsive to Cryovac's document requests bearing production numbers PPPI 013473-81. We are looking for the "draft document" and, assuming this document can be located after a reasonable search, we will get it to you as soon as we can.

Regarding Item No. 2, please be advised that although Mr. Douglas maintained files (which files have been produced to Cryovac) relating to Pechiney project no. 403499, he did not maintain a "project notebook related to Pechiney project no. 403499." I have asked our client to look into the remaining two (Mr. Buelow's "project notebook related to Pechiney project no. 403499" and Dr. Mueller's "notebook related to [ ] 1998 work with EVOH") items promptly. Assuming these documents can be located after a reasonable search, we will produce the requested documents as soon as possible.

Regarding Item No. 3, documents related to Stratos Dimas (f/k/a Efstratios Hatzidimitriu), Seymour Gilbert and Earl Hatley have been produced to Cryovac and, based on a search of Pechiney's production that we performed, include at least documents bearing bates numbers PPPI 008384-89, 8443-51, 8452-687, and 13473-81. Mr. Gilbert has been retained as a consulting expert by Pechiney. All communications between Messrs. Dimas, Gilbert and Hatley were through Pechiney's attorneys and are immune from production under the work product privilege.

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CC: "Joann Neth" <joann.neth@finnegan.com>, "Trybus, Steven R" <STrybus@jenner.com>, "Cassling, Donald R" <DCassling@jenner.com>

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## **PROCEEDINGS**

# **36th Annual Reciprocal Meat Conference**

of the  
**American Meat Science Association**

in cooperation with the

**National Live Stock and Meat Board**

**North Dakota State University  
Fargo, North Dakota**

**June 12-15, 1983**



PPPI 013473

# Environmental and Material Composition Effects on Film Permeability as Related to Meat Packaging

Seymour G. Gilbert\*  
Grace R. Huang-Lai  
Christopher C. Lai

## Introduction

The selection of a plastic film for packaging is often based on many factors. An overriding consideration for a foodstuff is the permeability of the package walls to various penetrants. The penetrants of major importance are moisture, oxygen and, in certain cases, carbon dioxide. Other substances, including organic vapors and aromas, are often important, depending on both the product and its environment during the span of its use.

Knowledge of the barrier properties of the film is essential in successful design of packaging to extend the product storage life. Different products have different film permeability requirements. In general, there are two types of packaged foods. First is the packaged non-living materials in which the useful storage period is governed by the degree of effectiveness of the package as a barrier to a particular penetrant or penetrants (Gilbert and Hayakawa, 1975). The second type is packaging of a living system, such as fresh meat or produce. These products have a number of complicating factors which are not present in the preceding case (Daun and Gilbert, 1974, 1979). A certain composition of gas and vapor is required in the package to maintain the desirable biological/biochemical activities of the system. Thus, proper film selection and optimizing package design are important in controlling product quality changes, such as color, aroma, texture, microbial growth, etc. Henig and Gilbert (1975) used computer-aided mathematical solutions to determine the equilibrium concentration of gases within a packaged produce and the time necessary to reach this condition. The technique could also be applied to package design for any commodity.

An understanding of the factors affecting film permeation would be desirable in package film selection and design of packaged product environment. In this presentation, we will first review the theory of permeation and various factors that affect film permeability. Then packaging requirements in terms of barrier properties for meat products will be presented.

## Theory of Permeation

The rate of permeation is defined as the amount of material passing through a membrane or film per unit of time.

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Reciprocal Meat Conference Proceedings, Volume 36, 1983.

The permeation rate of gas or vapor through a package is highly dependent on the package film composition, nature of the gas and the environment. Movement of small molecules through the polymeric systems may occur by at least three processes: (a) Activated diffusion of molecules through homogeneous amorphous material, (b) Flow through a discontinuity (pore or crack) in the material, or through faulty seal or seam, (c) Combination of the above two processes.

## Activated Diffusion

The activated diffusion process can be generally characterized by three steps. First, penetrant dissolving at one side of the film. Then it diffuses through the film under a concentration gradient. Finally, the penetrant evaporates from the other, lower-concentration, surface. Both first and third steps depend primarily on the solubility of the penetrant in the polymer, whereas the second step is diffusion dependent. The higher the solubility of diffusion rate, the more likelihood of greater movement of a gas or vapor.

For the steady-state activated diffusion process, the rate of mass flux of gas may be expressed by Fick's first law of diffusion:

$$q = -D \frac{dC}{dx} \quad (1)$$

where:

q = rate of diffusion per unit area of film in unit time  
D = diffusion coefficient  
C = concentration  
x = distance diffused at concentration C

If D is independent of the concentration or location in the film, the above equation (1) may be integrated between the two concentrations,  $C_1$  and  $C_2$  to

$$q = D(C_1 - C_2)/l \quad (2)$$

where:

$C_1$  and  $C_2$  = steady state concentrations of gas at both surfaces of the film  
l = film thickness

The gas concentrations of penetrant at both surfaces can be related to their partial pressure by means of Henry's law

$$C = Sp \quad (3)$$

where:

S = solubility coefficient of the penetrant in the polymer  
p = gas or vapor partial pressure

substitution of  $S_p$  for  $C$  in equation (2) gives

$$q = DS(p_1 - p_2)/l = P(p_1 - p_2)/l \quad (4)$$

$$\text{or } P = DS = q l / (p_1 - p_2) \quad (5)$$

The product  $DS$  has been defined as the permeability constant or permeability coefficient. This value is a constant at a given temperature when Henry's law is obeyed and that  $D$  is independent of penetrant concentration. When Henry's law is not obeyed, or the diffusion is concentration dependent, a non-linear pressure gradient usually exists. An example is the dual mode sorption mechanism of Vieth and Sladek (1965).

### Flow Through Pores

Penetrant size relative to pore or capillary and the viscosity of the penetrant are the governing factors of mass flux through the nonhomogeneous film. In the case of streamline flow of a single-component through capillaries, Poiseuille's law can be used.

$$q = \frac{\pi r^4}{8\mu L} (p_1 - p_2) \quad (6)$$

where:

- $r$  = radius of capillary
- $\eta$  = viscosity of the penetrant
- $L$  = length of capillary

For cases conforming to Poiseuille's law, the permeability coefficient varies inversely proportional to the penetrant viscosity, which increases with temperature (Hall, 1973). That is,  $P$  decreases with increase in temperature for large capillaries.

When the diameter of the pore is less than the mean free path of the gas molecules, the flow rate becomes independent of pressure and pore diameter. The flow can be described by Knudsen's law.

$$q = \frac{4r^3}{3L} \cdot \frac{(2\pi M)^{1/2}}{RT} (p_1 - p_2) \quad (7)$$

where:

- $M$  = molecular weight of penetrant
- $R$  = gas constant
- $T$  = absolute temperature

The flow, following Knudsen's law, is independent of penetrant viscosity and  $P$  decreases with temperature. This is in contrast with permeability governed by activated diffusion, where the mass flow rate increases exponentially with temperature.

### Simultaneous Diffusion and Flow Through Pores

Frisch (1956) derived an equation for combined diffusion and convection through polymer films possessing pores. At steady state gas flux, where  $D$  is assumed constant and local solution equilibrium is attained at the walls of the pores,  $q$  is given by:

$$q = D \frac{d}{dx} \left( \frac{C}{1 + \phi} \right) + \left( \frac{C}{1 + \phi} \right) v \quad (8)$$

$$\phi = 1/SRTg \quad (9)$$

where:

- $v$  = convective velocity
- $S$  = overall solubility coefficient
- $g$  = constant factor which is inversely proportional to the total pore volume

Common units used for permeability constant are: CC(STP) · mil/m<sup>2</sup>/24hr/atm; CC(STP) · mil/100in<sup>2</sup>/24hr/atm; CC(STP) · cm/cm<sup>2</sup>/sec/cmHg and gm/m<sup>2</sup>/24hr/atm. When comparing permeability constants, one should be very careful to note the units used, or else one material might be mistakenly assumed to be a better barrier than another, while in reality that is not the case.

In addition, there is a common misconception among people regarding a film, like polyethylene, as having a high gas permeation rate relative to water vapor permeability (Gilbert, 1981). This notion probably arises from the usual unit used for the permeability constants: water being in grams, and gases like oxygen in cc. At equivalent gauge, area and time, these two quantities are related by a factor of 24,400/18 or 1,244/1. The driving forces are also not equal. Thus, the normalizing factor for water vapor transmission in the standard transfer units is about  $4 \times 10^4$  for water to that for a fixed gas.

### Factors Affecting Film Permeability

The rate of gas or vapor permeation through a polymeric film depends on a number of parameters.

#### Nature of Penetrant

Diffusion coefficient and permeation rate are decreased as the size and shape of penetrant molecules increases. The shape factor is especially important as in the case of organic molecules. For branched or cyclic penetrant, the diffusivity is much lower than their linear counterparts of the same molecular weight.

In most cases the permeability of polymers to penetrant increases with similarity of structure, the well known principle of "like dissolves like," and ease with which the penetrant can condense on the barrier material. For example, water vapor has a very low solubility value in hydrophobic polymers, such as polyethylene. As a result, water vapor permeability through polyethylene is much lower than through the hydrophilic materials, such as the cellulose and nylons. However, the water vapor permeation rate through polyethylene is higher than that of oxygen which has about the same molecular size because of the difference in liquefaction temperature.

The permeation process of organic vapors is quite complex due to the pressure-dependent solubility and the concentration-dependent diffusion coefficient. The solubility of organic vapors does not follow Henry's law. In addition to being penetrants, these vapors behave as solvents or plasticizers which swell the polymer and lead to increased polymer chains and penetrant mobilities. It should be noted that since the solvent-film interaction varies with each polymer, comparison of organic vapor permeabilities cannot be made in a similar fashion as is possible for gases and water vapor.



In general, mixtures of gases have no interaction on their film barrier properties. The gases permeate independently according to the partial pressure of each gas. On the other hand, the effect of mixed vapors depends entirely on the individual penetrant's behavior toward the polymer. Complex situations could occur when mixtures contain at least one penetrant that swells the polymer. Swelling due to the water or organic vapor increases the flux of other penetrants. Effect of swelling due to water sorption depends on relative humidity and not on the percent of water vapor in the gas. The presence of water vapor also has an accelerating effect on diffusion of organic vapors in polymers such as polyvinyl acetate and cellulose acetate (Long and Thompson, 1954).

The effect of relative humidity on oxygen permeation of various common films is shown in Figure 1. Hydrophobic polymers give a relative constant rate of permeation all through the range of relative humidity, whereas the hydrophilic materials show a rapid increase of gas flow at higher relative humidity. These curves, which refer to material approximately 0.001 in. thick, are based partly on data given in the literature and partly on practical observations on a limited number of samples in our laboratory. They indicate only the probable order of magnitude and not the specific performance which can be expected from materials from different sources of supply.

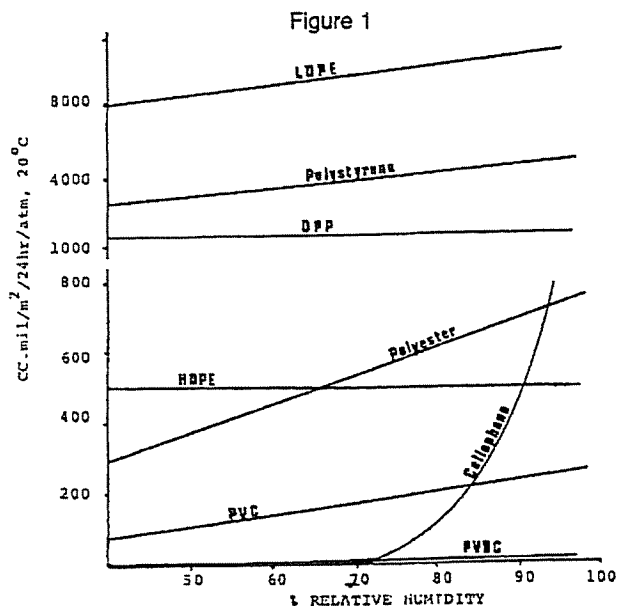


Figure 1. Effect of %rh on  $O_2$  permeability of various films.

### Temperatures

The temperature relationship to diffusion and solubility over a small range of temperature can be represented by Arrhenius type relation if the penetrant does not swell the polymer.

$$S = S_0 \exp(-H_s/RT) \quad (10)$$

$$D = D_0 \exp(-E_D/RT) \quad (11)$$

where  $H_s$  and  $E_D$  are apparent heat of solution and activation energy for the diffusion process, respectively, and the subscript zero refers to a standard state. Consequently, from the

definition  $P = DS$ , the temperature dependence of the permeability constant is as follows:

$$P = P_0 \exp(-E_p/RT) \quad (12)$$

where:

$$E_p = H_s + E_D \quad (13)$$

$E_p$  is the activation energy for the overall permeation process, and  $H_s$  can be expressed as sum of the heat of condensation and the heat of mixing.

$$H_s = H_{\text{cond}} + H_{\text{mix}} \quad (14)$$

As the temperature increases, the value of diffusion coefficient increases, and solubility decreases or increases depending on whether  $H_s$  is determined largely by  $H_{\text{cond}}$  or  $H_{\text{mix}}$ . The dependence of solubility on temperature, however, is small in comparison with that of diffusion coefficient. Therefore, the overall  $E_p$  is positive and permeation increases with an increase in temperature.

The overall activation energies of numerous penetrant/barrier systems have been reported in the literature (Crank and Park, 1968; Meares, 1965; Yasuda and Stannett, 1964). These values may be used to calculate the permeabilities at other temperatures using the following relationship (Yasuda and Stannett, 1964):

$$\log P_2 = \log P_1 + \frac{1000E_p}{4.6} \left( \frac{1}{T_1} - \frac{1}{T_2} \right) \quad (15)$$

where  $P_1$  and  $P_2$  are the permeability coefficients at temperatures  $T_1$  and  $T_2$  respectively.

### Light and Irradiation

Light usually does not affect the barrier properties of film. There has been considerable activity in recent years in the sterilization of already packed foods by irradiation through the package. The effect of  $\beta$  or  $\gamma$  irradiation of a polymer on solubility and diffusivity depends primarily on the crosslinking to scission ratio (Rogers, 1964). The magnitude of the observed effects generally increases proportionally with the dose.

### Film Thickness

The rate of permeation is always inversely proportional to the film thickness if equilibrium conditions have been established. In the case of pre-equilibrium, thickness of polymer improves its barrier properties much more than it does after reaching equilibrium, since the time needed to reach equilibrium is roughly proportional to the square of the thickness if Fick's and Henry's laws are obeyed (Lebovits, 1966).

### Nature of Barrier Material

A number of film properties have an effect on the rate of permeation. Since penetrant-polymer interaction has considerable influence on the film permeability, the following material factors should be interpreted as only a general trend.

Structural modifications of polymer usually changes the diffusion and permeability coefficient. These are attributed to alterations of the chain mobility, cohesive energy, and hole volume or "looseness" of the polymer structure. Thus, any increasing quantities such as density, degree of crystallinity,

orientation, cross-linking, saturation, length or polarity of side groups, as well as additives such as plasticizers and fillers in a polymer molecule, will generally reduce the permeability. For example, in our studies on the effect of cross-linking on the permeability of collagen (Lieberman and Gilbert, 1973), data show that both the permeability and diffusion coefficients decrease with increasing degree of cross-linking (Table 1). When the chain segments are tied together at intervals by cross links, the probability of the polymer chains moving away from the same central point and forming a hole for passage of the penetrant will decrease. The same considerations probably apply to inter-molecular "cross linkages" involved in crystalline structures.

### Composite Film

Composite structures, including laminations and coated materials, are often used to provide a definite function, such as heat sealability, structural and barrier characteristics, etc. It is usually impractical and uneconomical to reduce permeability by increasing the thickness of one material. Consequently, a more practical way of obtaining the desired permeability and possess other functional requirements is by coating or lamination of the film with one or more other materials of better barrier properties. Table 2 demonstrated

**Table 1. Oxygen Permeability of Formaldehyde Cross-Linked Collagen Films**

Molecular Weight Between Cross-Links	$P \times 10^{13} (\text{cc-cm/cm}^2/\text{sec/cmHg})$	
	86.5%RH	91.0%RH
6100	1109	1301
4300	1277	1348
3400	1480	1636
2700	1648	1816

Ref. Lieberman and Gilbert, 1973

**Table 2. Permeability (P) for Selected Plastic Films**

Film	Oxygen <sup>a</sup>		Water Vapor <sup>b</sup>	
	U	F	U	F
Polypropylene	889	1152	0.22	0.30
Foam PP	2529	6660	0.56	1.52
Foam PP/PVDC	456	2153	0.02	1.09
Coated One side				
PP/PVDC/PVDC/PP	92	819	0.02	0.13
Lamination				
PE/NYLON/PE	174	230	0.94	1.13
Co-Extrusion				

<sup>a</sup>CC/m<sup>2</sup>/24hr/atm at 23°C

<sup>b</sup>gm/m<sup>2</sup>/24hr at 23°C, 90%RH

U = flat unflexed sheet

F = film partial flexed 20 cycles  
(ASTM method F-392-74)

(Gilbert and Lai, 1982)

the effect of PVDC coating and laminate on permeation. The permeation rate for composite film is independent of the order in which the layers are assembled, if D for each layer is constant. In steady-state, the overall permeation coefficient of flow through a barrier of total thickness of 1 composed of n layers is given by

$$\frac{1}{P} = \sum_{i=1}^n \frac{X_i}{P_i} \quad (16)$$

where:  $X_i$  = thickness of the  $i$ th layer

$P_i$  = individual permeability coefficient of the  $i$ th layer, independent of pressure and concentration.

However, if one of the layers would interact with the penetrant, then the rate through the composite will be dependent on the direction of flow. For instance, while packaging liquid flavor concentrate with PVDC coated polyethylene, it was found that the film with coated side toward the product had a better barrier against flavor loss than if it was packaged in reverse (Talwar et al., 1973).

The co-extrusion technology has great impact on the making of flexible packaging materials in the areas of performance and flexibility of composite webs. Combinations of materials can be simultaneously extruded through a die by the co-extrusion process to achieve structures that provide high performance at reasonable costs. Since it is a one-step process and solvent-free, co-extrusion offers additional potential economic and environmental advantages as compared with the laminating and coating operations. High barrier co-extruded films have been designed for use in packaging snacks and other foods. These films can be designed with hydrophobic exterior polymers with high barrier but water-sensitive cores, such as ethylene vinyl alcohol. Table 2 illustrates one possible combination.

### Mechanical Damage

In practical situations, barrier materials are often creased and subjected to other adverse effects as a result of flexing that occurs during machining and handling of the film and finished package. These abuses can lead to increases in gas or vapor permeability due to structural damage of the polymeric film.

A Gelbo Flex tester was used to simulate the package abuse (Gilbert et al., 1983). Numerous pinholes could be seen by naked eyes on flexed glassine. On the other hand, flexed PE/NYLON/PE co-extruded was only wrinkled without visible pinholes. Among all the flexed films studied, nylon extrusion gave the best resistance to mechanical damage and barrier against organic vapors. Effect of flexing on oxygen and water vapor transmission of selected plastic films are also presented in Table 2. It can be seen that flex damage is a function of nature of the film, coating, laminate or co-extrusion.

### Barrier Requirements for Packaged Meats

The preceding discussion has considered the mechanisms and factors affecting film permeation. Combining this information and understanding the micro-environment of the product, one should be able to select and design optimum

packaging materials in terms of barrier properties for packaged meat and meat products.

The science and technology of meat packaging have been reviewed by many authors (Mills and Urbin, 1960; Brody, 1970; Sacharow and Griffin, 1970; Daun and Gilbert, 1979; Rizvi, 1981). In the following, we shall examine how permeation relates to quality of packaged meats. Some unpublished data from our research will be presented.

### Fresh Meats

There are two conflicting conditions for packaging of fresh meats. Oxygen permeable film is required to maintain the desirable red oxymyoglobin pigment. On the other hand, a relatively gas impermeable film is needed to minimize microbial growth. The chemistry of meat pigments has been discussed by Fox (1966). Landrock and Wallace (1955) studied the role of film oxygen permeability to fresh red meat color. They found that the minimum oxygen permeability requirement is about  $5,000 \text{ ml/m}^2 \cdot 24 \text{ hr} \cdot \text{atm}$  at  $75^\circ\text{F}$ . This requirement has been shown by Daun et al. (1971) to be fortuitous as it is determined largely by the oxygen demand of the indigenous microflora and not the meat pigment. A review of the relationships of microflora to packaged meats was given by Ingram (1962). The storage life of the vacuum packaged meat, as assessed by discoloration and development of putrefactive odors, was shown by Newton and Rigg (1979) to be inversely related to film oxygen permeability in keeping with the principle that microbial growth is the key relation to  $\text{O}_2$ .

In practice, a film highly permeable to oxygen is used for packaging fresh meats to be stored only 2 or 3 days. Rizvi (1981) listed the film oxygen permeability requirements for various meat packaging (Table 3) without consideration to the microbial factor. Other requirements are low water vapor permeation rate, impermeability to foreign odors and several physical properties including flexibility, clarity, high wet strength, nontoxic, grease proof and durability at low temperatures.

Fresh meats could have a much longer storage life if they were vacuum packaged in oxygen and water vapor impermeable film. However, the anaerobic condition causes the formation of purplish red color of reduced myoglobin. In one of our studies, we monitored the color changes of vacuum packaged meats with time (Gilbert et al., 1981). One group of beef chunk steaks was vacuum packed (Group-V) in PE and

PP laminated pouches, while another group was packed with about 100 cc of air in the headspace of the pouches (Group-A). One half of each group was kept under fluorescent light and the other half was stored in darkness at  $3^\circ\text{C}$  environment. Changes in meat surface color were measured with a Hunter Color Meter (D25P-2).

Both oxygen and carbon dioxide permeabilities of the pouch material were determined, and their values were 1273 and  $7036 \text{ cc/m}^2/24\text{hr/atm}$  at  $23^\circ\text{C}$ , respectively. The oxygen permeation rate is higher than the recommended rate for vacuum packaged fresh meat as listed in Table 3. However, it is well below the value suggested for fresh retail cuts.

The color of meat for all packages turned brownish in two days. No color differences were observed between packages stored under fluorescent light and those kept in darkness. Changes in the loss of red color ( $\Delta a$ ) and loss of brightness ( $\Delta L$ ) are shown in Figures 2 and 3, respectively. Gas composition within the package was determined using the gas

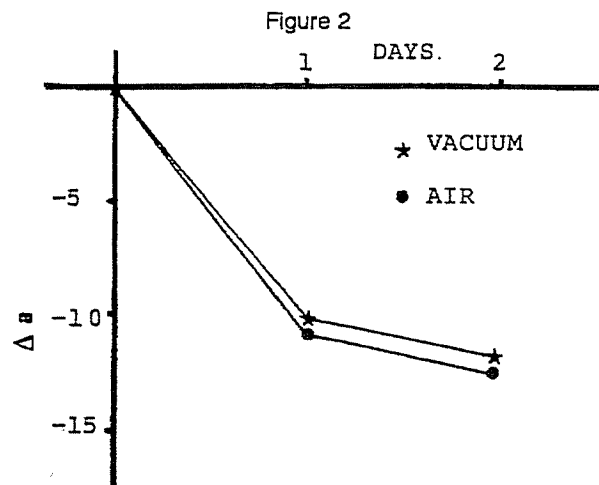


Figure 2. Changes in loss of redness ( $\Delta a$ ) of packaged fresh beef samples.

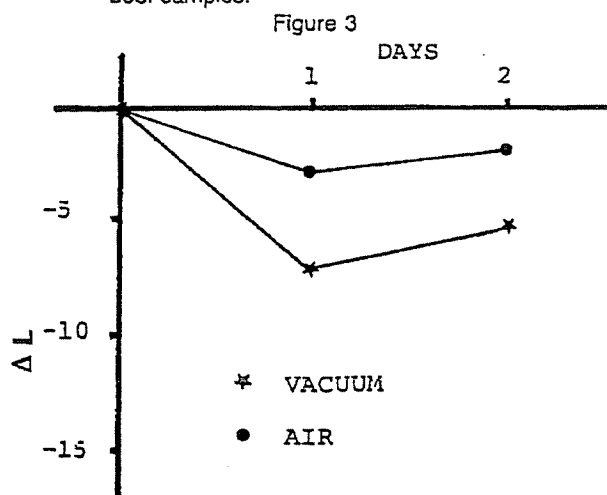


Figure 3. Changes in loss of brightness ( $\Delta L$ ) of packaged fresh beef samples.

Table 3. Film  $\text{O}_2$  Permeability Requirement for Meat Packaging

Product	P	Comments
Fresh Retail Cuts	5000	Oxygenation of Myoglobin Meat Blooms
Vacuum Packaged Fresh Meat	40	Retards Myoglobin Conversion to Metmyoglobin
Cured Meat	100	Retards Degradation of Nitric Oxide Myoglobin
Vacuum Packaged Processed Meat	15	Minimum Degradation of Nitric Oxide Myoglobin

P =  $\text{CC/m}^2/24\text{hr/atm}$  at  $23^\circ\text{C}$

(Rizvi, 1981)



chromatographic technique. Gradual increase of  $\text{CO}_2$  was found for both groups with substantial decrease in headspace oxygen of Group-A. It was suspected that the color changes were due to the oxidizing of myoglobin to metmyoglobin by microbial metabolites. Group-V showed relatively low microbial activities, due to lack of oxygen inside the packages. However, sufficient oxygen might be present in the meat surface fluid to allow microbial metabolites to form, which changed the meat to the undesirable brownish color.

Gilbert et al. (1981) further investigated the effect of initial bacterial load on the color stability of packaged meat. Two meat samples, Meat-Hi and Meat-Low, with initial bacterial load of  $2.5 \times 10^4$  and  $2 \times 10^2$  count/cm<sup>2</sup>, respectively, were vacuum-packaged with the PE/PP laminated pouches. Both samples were stored at 3°C in darkness.

Figure 4 shows the redness changes of both packaged meats. An arbitrary interpretation of visual color acceptability in terms of redness (a value) was used according to Rickert et al. (1957). Meat-Hi with higher initial bacterial load started to turn brown after 3 days of storage, whereas Meat-Low with low initial bacterial load maintained redness in the satisfactory region after 7 days of storage. The bacterial loads after 7 days were  $3 \times 10^5$  and  $7 \times 10^3$  counts/cm<sup>2</sup> for Meat-Hi and Meat-Low, respectively.

The results show that it is possible to maintain an acceptable red meat color up to a week with an intermediate oxygen permeability material under the condition which avoids an undue initial load of microorganisms and at low temperature restriction growth. It is concluded that much of the literature concerning permeability requirements of fresh meat is not valid for commercial meats when the relation to microbial competition for oxygen is not considered. Gilbert and Daun (1971) had previously demonstrated that true oxygen demand by sterile excised meat discs for maintaining redness color is quite low, whereas higher demands reflected the microbial status of the meat under specific test conditions.

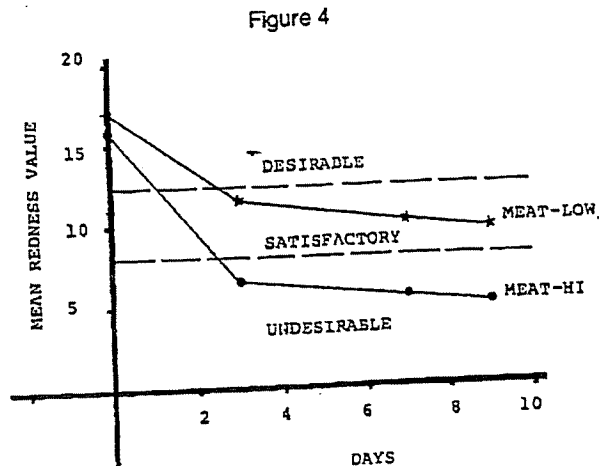


Figure 4. Redness changes of packaged fresh beef samples with different initial bacterial loads.

### Frozen Meats

Frozen packaged meat has become more and more acceptable in the wholesale and institutional trade, but frozen retail cuts constitute only a small part of the market at present. The primary concern for the frozen storage of meat is the problem of freezer burn. This is caused by severe moisture loss from the surface layers. To prevent water vapor migration, void spaces in the frozen packages should be restricted and the temperature during the storage should be kept relatively constant. The meat should be in a skintight package as with a shrinkable film that has low permeation to oxygen, water vapor and volatile flavor components.

Another study was conducted with the same set-up as described in the experiment with fresh meat except the meats were frozen immediately after cutting, before packaging (Gilbert et al., 1981). The meats packaged with air were shown to have much brighter red color than in the vacuum packages. Vacuuming has significant ( $P < 1\%$  level) effect on the changes in loss of brightness ( $\Delta L$  value) of frozen meat which indicated that the meat brightness is directly related to availability of oxygen to meat surface (Figures 5 and 6). On the other hand, there was evidence of light effects ( $P < 5\%$  level) on the color of the meat (Figure 7).

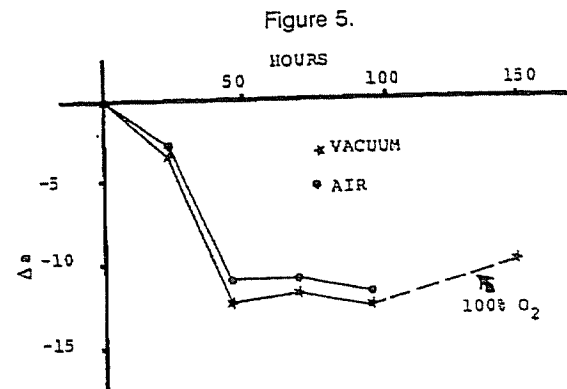


Figure 5. Changes in mean  $\Delta a$  values of packaged frozen beef.

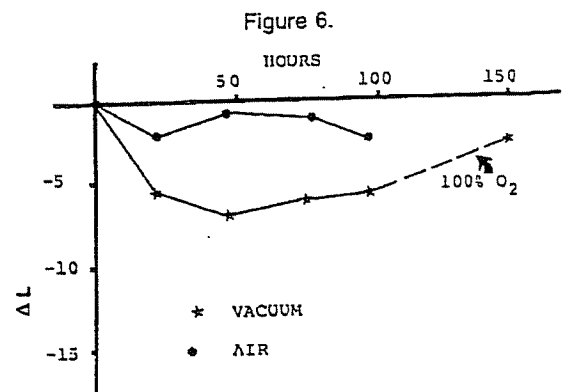


Figure 6. Changes in mean  $\Delta L$  values of packaged frozen beef.

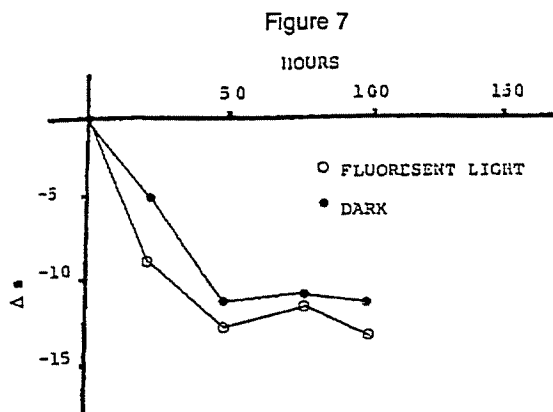


Figure 7. Effect of light on changes of redness ( $\Delta a$ ) of packaged frozen beef.

The vacuum packaged meats were opened after seven days of storage and exposed to 100%  $O_2$ . The changes in both a and L values were shown by the dotted line in Figures 5 and 6. These results demonstrated the reversibility of purplish red color to bright red color. However, the reversible process was not complete, probably due to some of the meat pigments being already in the oxidized stage (metmyoglobin).

#### Processed Meats

Processed meats, such as frankfurters and luncheon meats, should be protected from light and oxygen. A vacuum package with a film of relatively low oxygen and water vapor permeability can aid considerably in extending the product's shelf life.

Gilbert and Huang-Lai (1982) have studied the shelf life of ham packaged with cook-in films, a special packaging technique which combines shrink film, thermoforming and vacuum sealing. The product was filled in a pre-formed package before cooking, then sealed into a semi-rigid container. During the cooking cycle it shrinks around the product to assume the final taut configuration.

Fourteen lbs. size ham samples packaged in 9 different film materials supplied from Allied Fibers and Plastics (Morristown, NJ) were used to evaluate the product stability stored under 35°F in darkness. All of the films have good barrier properties (30 to 93cc/m<sup>2</sup>/24hr/atm for  $O_2$  permeability). Sensory and microbiological qualities were determined after three months of storage,  $CO_2$  concentration of fluid within packages was also measured. Good correlation was found between  $CO_2$  concentration and aerobic bacteria count ( $r = 0.8$ ). The bacterial load on packaged hams was within commercially acceptable levels. However, sensory qualities (surface color and aroma) were judged to be slightly less acceptable as compared with a reference sample of freshly packaged ham. It was found that the best product storage stability was related to the film that gave excellent shrinkage with tightly packed packages. Loose pockets of ham fluids within the packages are undesirable. These provided a media for the bacteria to grow and the liquid could also contribute to the pale faded surface appearance of the ham by washing off the color pigments.

#### Conclusion

Film permeability properties are of major importance to the shelf life of packaged meats. Theory of permeation and various factors that affect permeability have been presented to show the parameters of this aspect. The practical relations of permeation to quality of packaged meats were also examined. It is concluded that much of the literature concerning barrier requirements for fresh meat is not valid since the relation to microbial competition for oxygen was not considered. The oxygen demand by sterile fresh meat is quite low. Thus, most of the permeated oxygen is used in bacterial growth. Controlled atmosphere (high  $O_2$  and  $CO_2$  or low  $O_2$ ) in relatively impermeable films storage provides one route to regulate both meat pigment and bacterial growth but this system requires close control of initial microflora, particularly with high initial oxygen level.

New Jersey Agricultural Experiment Station, Publication No. 10507-1-83, supported by State funds.

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ALCAN PACKAGING

Pechiney Plastic Packaging, Inc., an Alcan company  
 8770 W. Bryn Mawr Avenue Tel.: (773) 399-8000  
 Suite 600 Fax: (773) 399-8648  
 Chicago, IL 60631 www.alcanpackaging.com  
 USA




### INDEMNIFICATION AND HOLD HARMLESS AGREEMENT

Pechiney Plastic Packaging, Inc., ("PPPI"), a Delaware corporation and an Alcan Company, hereby agrees to indemnify, defend, and hold harmless National Beef Packing Company, LLC, ("National Beef") from and against any suit, proceeding, or action (collectively, a "Claim") that may be brought against National Beef, its agents, employees, officers and directors, by any third party (the "Claimant") alleging that any products manufactured and sold by PPPI to National Beef infringes the intellectual property or proprietary rights of the Claimant; provided, however, that the foregoing indemnity shall be effective only if National Beef (a) promptly furnishes written notice to PPPI of the Claim, (b) provides PPPI with adequate authority, information and prompt assistance and cooperation for the defense of the Claim, and (c) promptly delivers to PPPI copies of all documents relating to the Claim, and (d) makes available to PPPI all defenses against the Claim that may be known or available to National Beef, and (e) promptly makes available to PPPI all witnesses, pertinent records, materials and information in National Beef's possession or control as may be reasonably required by PPPI from time to time.

PPPI's assumption of the defense of any Claim shall not constitute a waiver by PPPI of any defenses it may assert against the National Beef's claim for indemnification under this Agreement.

IN WITNESS WHEREOF, the parties have caused this Agreement to be executed and delivered on the date written below.

5  
 PECHINEY PLASTIC PACKAGING, INC.

  
 Name: Robert G. Taylor  
 Title: Vice President / General Manager  
 Meat & Dairy

Dated: As of June 30, 2005

Pechiney Plastic Packaging, Inc. An Alcan Company, 8770 West Bryn Mawr Avenue, Chicago, Illinois 60631

CONFIDENTIAL SUBJECT  
 TO PROTECTIVE ORDER

PPPI 013482

# EXHIBIT 10









MINERAL PLASTICS

THE JOURNAL OF COMMERCE, MONDAY, DECEMBER 14, 1987

## Purchase Chemical

Chemical sales Co. that they agree to purchase the shares from rice of \$750

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## Accident Spurs Look at OSHA

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As well as bringing new businesses to ICI which are profitable in their own right, Beatrice Chemical's strong market and distribution position in specific fields will provide a powerful vehicle for ICI's own new products and technology. Beatrice Chemical will also provide a valuable complement to ICI's interests in acrylic polymer intermediates for paints and coatings, while the overall acquisition is a further major step in the growth of ICI's business in the United States.

Beatrice Chemical, which employs 3,500 people and has operations in 12 countries, principally the United States, Canada and Europe, is composed of several businesses. Fiberite Composite Materials is a market leader in the supply of advanced composites to the defense and aerospace industries, while LNP is a leading independent supplier of reinforced thermoplastics compounds in the United States. The materials businesses also include Fiberite Molding Materials, which has a strong position in reinforced engineering plastics, and Dri-Print Foils, which manufactures decorative and functional hot-stamping transfer foils.

Beatrice Chemical's other businesses are primarily in the supply of specialty chemicals and associated customer services. Stahl and Pauls Chemicals are world leaders in the supply of finishes for leather.

"This is our largest acquisition since we bought Atlas Chemical Industries Inc. in 1971," said Brian Smith, ICI director for the Americas.

Isocyanate, had not been inspected since 1982. A Dec. 3 leak of the poisonous chemical in Bhopal, India, killed more than 2,000 people.

In response, OSHA officials said workers at the Institute plant appeared "well-protected," and that top inspectors were now inspecting evacuation and safety procedures.

"The agency has conducted 32 inspections of that facility since 1973, 11 of these since 1980," said Robert Howland, assistant Labor secretary for occupational health and safety. He said the agency does not have the resources to inspect every plant every year.

"I think from what I have seen, it appears to be a safe plant."

Dick James, a Machinists union official at Institute, also testified that workers at the West Virginia plant

## Nylon Film Effective Packaging

Journal of Commerce Staff

A study recently undertaken for Allied Corp.'s Engineered Plastics Group, Morristown, N.J., shows that nylon film constructions provide cost-effective flavor and aroma protection for food packaging.

The research, conducted by Dr. Seymour Gilbert, who heads Rutgers University Food Science Department, compared the flavor and aroma barrier properties of commercially available packaging materials with common organic compounds associated with food ingredients and laminated materials used for food packaging.

The film materials tested included nylon, polyvinylidene chloride, ethyl vinyl alcohol and glassine. The results indicate that nylon provides good to excellent protection against the permeation of flavors and aromas and offers the most economic barrier per mil thickness.

Also, the study noted that nylon provides excellent grease and oil resistance and high-temperature performance as well as impact, puncture and tear-resistant properties. Coextruded films with thin nylon cores proved to have the broadest range of performance properties of the films tested with optimum flavor and aroma barrier.

These findings are important to packagers of shelf-stable foods including baked goods, candies, confections, flavor-enhanced cereals, cake mixes and snack foods that need to keep in their flavors for long periods and to keep out odors and flavors during handling, shipping and storage.

The Rutgers' study represents the first time that data has been compiled for specific permeants that affect flavor and aromas of packaging foods. The testing procedure involved the use of a special permeation cell developed by Dr. Gilbert. Test films were pre-conditioned and aged for 10 days at 70 degrees Fahrenheit at 100 percent relative humidity and Gelbo filled 20 times to simulate shipping and handling conditions.

Film samples were clamped in the permeation cell and test compounds in concentrations of 100 ppm were introduced to chambers within the cell. At intervals the concentrations of test compounds in the chamber were measured by gas chromatograph to determine the permeation rate of the compounds. The films tested included allyl sulfide (oil of

sensitive EVOH from heat degradation and flex cracking and serves as a moisture absorber. Both nylon and EVOH are said to have excellent oxygen barrier properties.

Rutgers is currently conducting additional testing for Allied. Different permeants and packaging structures will be used to further evaluate nylon's role as a flavor, aroma and odor barrier.

Allied is a leading supplier of nylon resins and films that are used for packaging cake mixes, frozen foods, candies, snack foods, processed meats and cheeses, medical devices and other demanding applications. For additional information on the Allied/Rutgers testing, contact Mr. Len Edson, Food Industry Manager, Allied Engineered Plastics, P.O. Box 23319, Morristown, N.J. 07960.

## New Workshops Explore Production Techniques

As more products are made with plastics, educators have found new ways to train students in the techniques of manufacturing with these materials.

However in doing so, they have been faced with some difficult problems. In order to set up effective courses, schools have had to rely on commercial equipment for heating, forming, reinforcing, cementing, welding and otherwise fashioning these modern materials. Because the machinery is priced for industry and several must be bought to cover the desired course material, capital costs run high. In addition, the machines are not designed or fixtured to further educational objectives or to withstand student wear and tear.

A new Plastics Workshop Bench, Model 2001, produced by Technovate/Yavin Plant now solves these problems.

The new Plastics Workshop Bench packs into just four square feet all the equipment and provides all the accessories needed to instruct students in twelve of the most used processes employed today in the manufacture of products made with plastics.

All the action is in plain sight at table-top height. In addition, the configuration of the table saves laboratory space and allows for clear aisles. The unit is fully self-contained and requires only 100 volt ac current to operate.

The Technovate/Yavin Plastics Workshop is distributed by Technovate Inc., Pompano Beach, Fla.

## PMA Offers '84 Edition Of Testing Handbook

The Polyurethane Manufacturers Association has published a revised

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considered it a safe facility.

## Swiss Chemical Sales Rise 8.2% for Quarter

Journal of Commerce Staff

ZURICH, Switzerland — Swiss  
chemical industry sales during the  
third 1994 quarter were up 8.2 percent  
from the like 1993 period. During the  
first nine months of this year they  
registered a 10.1 percent increase.

This advance for the January  
through September span was accom-  
panied by a 5.7 percent production  
rise. This, though, was not distributed  
evenly.

On the one hand, as reported by the  
Swiss chemical industry society, the  
output of dyes, lacquers, aromatic  
and organic chemicals, as well as  
synthetic products gained. While pro-  
duction of pharmaceutical products  
stagnated, that of pesticides was  
down sharply, and that of soap and  
detergents showed a lesser decrease.

laminated materials used for food  
packaging.

The film materials tested included  
nylon, polyvinylidene chloride, ethyl  
vinyl alcohol and glassine. The results  
indicate that nylon provides good to  
excellent protection against the per-  
meation of flavors and aromas and  
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mill thickness.

Also, the study noted that nylon  
provides excellent grease and oil  
resistance and high-temperature per-  
formance as well as impact, puncture  
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truded films with thin nylon cores  
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These findings are important to  
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involved the use of a special permea-  
tion cell developed by Dr. Gilbert.  
Test films were pre-conditioned and  
aged for 16 days at 70 degrees  
Fahrenheit at 100 percent relative  
humidity and Gelbo filled 20 times to  
simulate shipping and handling condi-  
tions.

Film samples were clamped in the  
permeation cell and test compounds  
in concentrations of 100 ppm were  
introduced to chambers within the  
cell. At intervals, the concentrations  
of test compounds in the chamber  
were measured by gas chromatog-  
raph to determine the permeation  
rate of the compounds. The items  
tested included allyl sulfide (oil of  
garlic) and acetic acid (vinegar),  
methyl ethyl ketone and ethyl acetate  
(solvents used in food packaging), and  
toluene (aromatic chemical used to  
simulate automobile and truck ex-  
haust).

The nylon film coextrusion outper-  
formed the other film structures  
tested with the exception of those  
including EVOH, which proved to  
have better permeation resistance to  
acetic acid, ethyl acetate and toluene.  
In all instances, however, the per-  
formance of the nylon film proved  
acceptable compared with EVOH,  
which is much more costly than  
nylon.

Nylon and EVOH can be used  
together in film structures, sand-  
wiched as a core between layers of  
high-density polyethylene or other  
polyolefins for moisture protection,  
to provide an extremely cost-effec-  
tive barrier to aromas, flavors and  
odors. Nylon forms an inseparable  
bond with EVOH, protects the more

## NEW WORKSHOPS EXPLORE Production Techniques

As more products are made with  
plastics, educators have found new  
ways to train students in the tech-  
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However in doing so, they have  
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run high. In addition, the machines  
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A new Plastics Workshop Bench,  
Model 2001, produced by Technovate/  
Yavin Plast now solves these prob-  
lems.

The new Plastics Workshop Bench  
packs into just four square feet all the  
equipment and provides all the acces-  
sories needed to instruct students in  
twelve of the most used processes  
employed today in the manufacture  
of products made with plastics.

All the action is in plain sight at  
table-top height. In addition, the  
configuration of the table saves labo-  
ratory space and allows for clear  
sides. The unit is fully self-contained  
and requires only 100 volt ac current  
to operate.

The Technovate/Yavin Plastics  
Workshop is distributed by Techno-  
vate Inc., Pompano Beach, Fla.

## PMA Offers '84 Edition Of Testing Handbook

The Polyurethane Manufacturers  
Association has published a revised  
"1984 Testing Methods for Polyure-  
thane Products" handbook, com-  
prised of more than 60 American  
Society for Testing Materials testing  
standards for urethanes. The new  
handbook includes 18 new standards  
for cast urethanes and also 25 testing  
standards for reaction injection  
molding in both cellular and solid  
elastomer categories.

"The revision of the handbook and  
the addition of the many standards is  
due to new technology in urethane  
applications and increasingly strin-  
gent testing requirements for them,"  
said Ron Haradzin, project manager  
for Mobay Chemical Corp. and chair-  
man of the PMA ASTM handbook  
subcommittee.

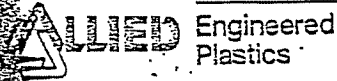
Copies of PMA's "1984 Testing  
Methods for Polyurethane Products"  
are available for \$40 to members and  
\$50 to non-members from PMA,  
Building C, Suite 20, 800 Roosevelt  
Road, Glen Ellyn, Ill. 60137.

Substrate	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Monomer	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Prepolymer	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Resin	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Filler	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Hardener	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Adhesive	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Sealant	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Coating	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Paint	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Ink	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Resin	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Filler	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Hardener	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Adhesive	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Sealant	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Coating	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Paint	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Ink	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Resin	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Filler	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Hardener	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Adhesive	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Sealant	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Coating	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Paint	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16
Ink	1.06	1.12	Substrate	1.10	1.16	Substrate	1.10	1.16	Substrate	1.10	1.16

PPPI 008460

# EXHIBIT 11

## News Release



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For Immediate Release

### RUTGERS STUDY CONFIRMS NYLON BARRIER PROPERTIES FOR FOOD AND OTHER SENSITIVE PACKAGING

Nylon film coextrusions offer the most cost-effective barrier for flavors, aromas, and odors for food and other sensitive packaging according to the results of a scientific study undertaken by Rutgers University for Allied Engineered Plastics.

The research project, directed by Dr. Seymour Gilbert, head of the Rutgers University Food Science Department, was the second such investigation commissioned by Allied.

Results from the first study, completed three years ago, also demonstrated nylon's cost-effective barrier properties. In that initial research, film materials tested included polyvinylidene chloride (PVDC), ethyl vinyl alcohol (EVOH), and glassine as well as nylon. Films with thin nylon cores proved to have the broadest range of performance properties with optimum flavor aroma barrier. Only EVOH offered better permeation resistance to acetic acid, ethyl acetate, and toluene, although the nylon films provided acceptable permeation resistance at a cost approximately half that of EVOH.

The second research project sought to determine whether nylon and EVOH in a single specification have a synergistic effect on flavor and aroma which would be cost-effective; and to test other film structures with additional permeants which have a broader range in simulating various flavors and aromas used in

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